AUSTRALIA'S ENERGY POLICY: A GAS UTILITY VIEW

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Australia has been called the world's largest island but it is really the world's smallest continent. Dry and sparsely inhabited, with only two cities of world renown and more sheep than people, the "Great South Land" (as early European explorers called it) is nevertheless a highly urbanised industrial country. Some 25% of civilian employment is in manufacturing, compared with 26% for Japan and 23% for the United States. Our gross domestic product in 1975 was 5,700 US dollars per head, compared with 7,120 for the United States and 4,450 for Japan. However, the Japanese economy was clocking up an average 7.8% real G.D.P. growth rate from 1960 to 1975, while Australia only managed 3.1% and the United States 2.5%.

Three million of Australia's 14 million population live in Sydney, the largest city. By contrast, about 9 million of Japan's more than 100 million people live in Tokyo and New York is home to about 8 million of the over 200 million United States citizens. The land areas of these three nations range from 377,000 square kilometres for Japan to 9,363,000 for the United States. Australia is a little smaller than the United States with 7,682,000 square kilometres. Her population, if evenly spread over the land mass, would live and work with a mere two persons per square kilometre. The comparable figure for the United States is 23 while Japan has 300 persons per square kilometre.

Only about 3% of Japan receives under 800 millimetres of rainfall annually, yet fully 88% of Australia is as dry as this. The United States figure is about 55%. Yet from Australia's dry northern and western regions comes exportable mineral wealth which now eclipses in value the agricultural staples on which the country has historically depended for external solvency.

A glance at the atlas will convey a better impression of Australia's economic assets and liabilities. First, as they say, the bad news. The continent is isolated from her four major trading partners, namely Japan (32% of exports/19% of imports), the United States (11% of exports/21% of imports), and the Association of South East Asian Nations (7% of exports/5% of imports). The distances in kilometres (by air) start at 3,347 (Darwin to Singapore), then climb through 7,817 (Sydney to Tokyo) and 11,242 (Melbourne to San Francisco), before reaching 14,500 (Perth to London).

Australia has not yet reached industrial maturity and is still a net importer of capital. The economic composition of imports reflects this fact, being heavily weighted in favour of plant and machinery, transport equipment, industrial inputs and fuels and lubricants. Finished consumer goods typically represent less than a fifth of total imports. The commodity composition of imports shows that mechanical machinery predominates with almost 17% of the total, followed by miscellaneous manufactures (13%), petroleum (10%), motor vehicles (10%), chemicals (9%) and electrical machinery (almost 9%).

The importance of transport equipment and fuels and lubricants in overcoming what one Australian historian has termed "the tyranny of distance" was foreshadowed in my remarks about isolation. The east-west distance from Sydney to Perth is 3,400 kilometres, with the Adelaide to Darwin journey from south to north almost as lengthy. To make matters worse, the bulk of Australia's secondary industry is situated within a narrow crescent connecting Sydney to Melbourne. The products issuing forth from Australia's south-eastern factories and workshops must be transported vast distances to reach consumers in the other capital cities and the country towns which serve the agricultural districts and mining projects to which I now turn.

Now for the good news. Australia's extreme geological age and size means that it encompasses most of the world's geological and climatic zones. Every mineral of commercial significance (except graphite and sulphur) is in production, along with such a quantity and variety of agricultural produce that food, beverages and tobacco represent less than 5% of imports. Australia's export income is principally generated by coal (12%); wheat, wool and iron ore (8% each); meat and alumina (6% each); and sugar (4%).

Australia's primary industries are much less geographically concentrated than its secondary ones. Coal from the productive seams around Blackwater fuels Queensland power stations and is exported through Gladstone. Wheat from the Wimmera-Mallee district around Horsham in Victoria is railed to flour mills in Melbourne and exported through Geelong. Wool from Goulburn in the Southern Tablelands of New South Wales is sold at auction in Sydney and exported. Iron ore from Mt. Tom Price in the Pilbara region of Western Australia is pelletized at Dampier and exported or shipped to the Kwinana steelworks. Bauxite is mined at Weipa in Queensland and treated to produce alumina, which is shipped to Bell Bay in Tasmania for smelting. Sugarcane is grown along the Queensland central coast and crushed in mills, with the product being exported through Mackay and other bulk handling ports. Uranium reserves are located in the Northern Territory in the far north, whilst oil and gas are produced in Bass Strait in the far south.

Within what kind of legislative restraints do Australian export industries operate? Politically, Australia is a federation of six States and two Territories. There is a bicameral Parliament in Canberra, the National Capital, consisting of a House of Representatives and a Senate on the United States model. However, the United Kingdom's Westminster system of government is followed, with an elected Prime Minister who appoints a Cabinet of elected politicians rather than calling on outside talent, as the American President does. The Senate is only nominally a House representing States' interests, as it almost always divides along party lines. Party discipline is strong within the current Government (Liberal Party/National Country Party) and Opposition (Australian Labor Party), so lobbying by interest groups is in general only successful if directed at the top men. Permanent heads of Government departments are also influential, as Acts of Parliament typically leave room for a lot of "administrative discretion", giving quasi-legislative power to the top bureaucrats. In addition, there are the Courts, who often place fresh interpretations on the Constitution, the Statutes and the Regulations made thereunder by the administrative wing of Government. The various State Parliaments operate in similar fashion, although of course confined to matters within their boundaries.

The Australian federation is more centralist than, say, the Canadian one, due to Canberra's control over the most lucrative tax bases, particularly personal incomes, sales turnover and imports. Power over the mining industry though, is much more under the control of the States. Each Government includes a Minister of Minerals and Energy (or equivalent), who approves applications for exploration leases. All minerals discovered become Crown property, but promising leases are almost invariably converted into mining tenements for exploitation by the successful prospecting company, which pays royalties to the Crown and may have to abide by other negotiated terms and conditions. The Australian Government receives a 40% share of offshore petroleum royalties and levies an excise tax on crude oil, although control of other seabed resources remains firmly in State hands.

Through its Bureau of Mineral Resources, the Australian Government supplies geological and economic information to the mining industry. It can control the export of certain metals, petroleum and petroleum products and all raw and semi-processed minerals. Government assistance is given in the form of income tax concessions on capital subscribed to mining ventures and direct subsidies to the industry. Commonwealth and State Ministers meet regularly to co-ordinate policies through the Australian Minerals and Energy Council.

Australia's Fossil Fuel Resources:

The problem of estimating Australia's energy resources is very difficult. An attempt has been made by the Federal Government's National Energy Advisory Committee (1) and most of the information in this note comes from this source. The term resources usually refers to that quantity of material that can be economically extracted. New technical developments and/or increases in prices can make previously identified sub-economic resources, economic. As well as identified resources there are usually considerable quantities of undiscovered resources (i.e. hypothetical and speculative). The National Energy Advisory Committee has used the McKelvey classification, Figure 1. On this basis, Australia's fossil fuel resources are shown in Table 1.

Table 1

Proven Economically Recoverable Australian Fossil Fuel Reserves - At December 1977.

(million terajoules)

State	Crude Oil	Natural Gas	Gas Liquids	Black Coal	Brown Coal	Total
Victoria	8.0	7.8	2.3	-	377*	395
New South Wales	-	-	-	252	-	252
Queensland	-	0.1	-	256	-	256
South Australia/ Northern Territory	0.3	3.5	0.9	9	4	18
Western Australia	0.8	18.8	3.4	8	-	31
Tasmania	-	-	-	2	-	2
Australia (approx.)	9.2	30.2	6.6	527**	381	954

* Based on 38 580 megatonnes of economically recoverable resources.
** Based on 20 260 megatonnes of economically recoverable resources.

Sources:

Crude Oil, Natural Gas and Gas Liquids - The Petroleum Newsletter No. 72 - Department of National Development.

Black Coal and Brown Coal - Australia's Energy Resources - an assessment. National Energy Advisory Committee No. 2.

Note 1 : Total figures are rounded out to the nearest whole numbers.
Note 2 : Resources which are relatively very small have been omitted.
Note 3 : Gas liquids are shown separately from crude oil and natural gas. Commonly, they occur together in the ground, but are separated in the treatment plant immediately after extraction, and are therefore quoted separately.
Note 4 : Western Australian Petroleum reserves includes those at Carnarvon and Bonaparte Gulf.
Note 5 : Conversion factors - terajoules x 10^6 (average)

= 237 million barrels of gas liquids.
= 166.3 million barrels of crude oil
= 0.92 tcf. of natural gas
= 38.4 million tonnes of black coal
= 102.5 million tonnes of brown coal

Although the above Table 1 follows the McKelvey classification, the figures for crude oil, natural gas and gas liquids include the reserves of the North West Shelf. The North West Shelf fields although not currently being produced have been included as they are presently being assessed for future development. Table 1 lists only conventional fossil fuels and ignores shale oil, uranium and thorium.

The following comments expand the information shown in Table 1 for the various fuels.

Petroleum Fuels:

(a) Crude Oil:

At December, 1977 some 9.2 million terajoules (TJ) of crude oil was estimated to be economically recoverable. This is a known and demonstrated quantity. Potential still exists for more discoveries (1). It is estimated that a 90% probability exists for finding an additional 9.3 million TJ (1,550 x 10^6 barrels). To find an additional 39.1 million TJ (6,500 x 10^6 barrels) the probability is believed to be around 10%.

(b) Natural Gas:

The economically recoverable quantity of sales gas is put at 30.2 million TJ (28 tcf.). As with crude oil, potential still exists for future discoveries. The probability of finding an additional 32.9 million TJ (30 tcf.) is estimated at 80%. This probability declines to only 20% for an additional 65.8 million TJ (60 tcf.).

(c) Gas Liquids:

This includes condensate and L.P. gas. In terms of size they are an important resource and total 6.6 million TJ (1,560 x 10^6 barrels). This is not much smaller than crude oil at 9.2 million TJ. It is considered (1) that an 80% probability exists for finding an additional 5.2 million TJ (1,240 x 10^6 barrels). To find 16.8 million TJ (3,980 x 10^6 barrels) the probability is only 20%.

Black Coal:

The economically recoverable quantity of black coal shown is 527 x 10^6 TJ (20,260 million tonnes). However, there are at least 4.4 times this quantity in the identified inferred category as shown on Figure 2.

Identified sub-economic resources of coal are very large. For example, the Cooper and Pedirka Basins in South Australia contain 3 trillion tonnes of coal (78,000 x 10^6 TJ) at a depth between 1,400 and 4,000 metres. In addition, considerable scope exists for future discoveries. Figure 2 summarizes the position for black coal. It is important to note that as the price of black coal increases or as new technologies develop the quantity of coal classified as an economic resource can be increased considerably.

Brown Coal:

Economically recoverable brown coal is situated primarily in Victoria and totals 381 x 10^6 TJ (39,000 million tonnes). Identified and demonstrated sub-economic resources total an additional 265 x 10^6 TJ (27,128 million tonnes). Identified and inferred sub-economic quantities are very large with at least 54,000 million tonnes in Victoria. Undiscovered categories are also likely to be large. Figure 3 summarizes the position for brown coal.

Australia's Fossil Fuel Demand:

A demand forecast for internal consumption to the year 2000 has been prepared using the Federal Government's Department of National Development latest projections (2) to 1986/87 and then extending those to the year 2000. Average growth rates, annual use and cumulative demand to the year 2000 are shown in Table 2.

Table 2

Fuel	1976/2000 Growth p.a.	Annual Use TJ x 10^3 1976	Annual Use TJ x 10^3 2000	Cumulative Demand TJ x 10^3 1976/2000
Black Coal	4.8	749.9	2 289.7	35 315.5
Brown Coal	4.0	289.9	753.4	11 980.9
Oil	2.6	1 255.3	2 331.6	44 250.5
Natural Gas	5.7	212.8	800.9	14 152.8
Total	3.8	2 507.9	6 175.6	105 699.7

Table 3 shows the relationship between the cumulative use of fuels from 1976 to the year 2000 and total economic resources of fuels.

Table 3

Fuel	Cumulative Demand TJ x 10^3	Economically Recoverable Resource TJ x 10^3	% Depleted
Black Coal	35 315.5	527 000	6.7
Brown Coal	11 980.9	381 000	3.1
Oil	44 250.5	9 200	- 381.0
Natural Gas	14 152.8	30 200	46.9

The position for oil and natural gas is not good. The cumulative requirement for natural gas will result in the consumption of almost half the economic resource by the year 2000. This however, understates the position as 18 x 10^6 TJ of natural gas are located at the North West Shelf and will be used primarily for export. For oil the situation is even worse as known reserves are completely inadequate representing only 21% of the cumulative demand to the year 2000.

Australia is well endowed with black and brown coal. Cumulative consumption of black coal to the year 2000 of 35 million TJ will only consume 6.7% of current economic resources. With 60 x 10^6 tonnes of black coal exported per annum for 24 years at an average heating value of 26 gigajoules (GJ) per tonne an additional 37 million TJ would be consumed. With exports and domestic consumption 13.8% of the black coal resources would be utilized. However, as noted in the previous section it is estimated that there is at least 4.4 times the quantity of black coal stated in Table 3 that is suitable for mining. With these resources the percentage used by the year 2000 would be close to 3%.

The position for brown coal is good with only 3% of economically recoverable resources being used by the year 2000. Considerable potential exists for enlargement of these resources.

Natural Gas for the Future:

As explained earlier, the population of Australia and the major concentration of its industry is in the south-eastern corner of the continent. The resources of natural gas not yet committed to customers and the most prospective areas for further gas discovery are in the north-western corner. The distance between these two is 4,000 kilometres and the cost of a pipeline system to bring this gas to Eastern States was estimated (3) in 1976 to be $1,600 million. The alternative of liquefaction in the north-west and transport by ship to the Eastern States, evaluated over a 20 year period, was less attractive than a pipeline.

Such a pipeline must cross four State boundaries, and its cost would be such that the gas utilities could find difficulty in financing such a project. It would therefore seem appropriate for it to be a Commonwealth Government project but so far the Government has not made any commitment.

Against the background of resource availability described earlier all gas utilities are confronted with planning problems. The following description of those confronting the Gas and Fuel Corporation of Victoria is given as a typical example.

The Gas and Fuel Corporation supplies 700,000 residential consumers and in addition, supplies industry in the reticulated area with 81% of its secondary energy needs (excluding electricity). It has maintained a strong campaign to convert all stationary uses of liquid fuels to natural gas both in its own interest and in its perception of the interest of the Government to minimize dependence on oil. The natural gas distributed in Victoria is obtained from the Bass Strait gas and oil fields under long term contracts which also provide options over any future discoveries. It is assumed in forecasts of the future that the price of gas from these sources will allow natural gas in the market place to maintain its competitiveness with oil and electricity. Competition does exist from solid fuels but is limited to very large users away from urban areas where clean air requirements make solid fuel uncompetitive. Market growth for natural gas will therefore be dependent on such fundamentals as population growth, industrial development and changes in living habits. On the other hand, growth may be neutralized by community adoption of energy conservation objectives, such as insulation of homes, re-cycling of materials, efficient designs of homes and efficient designs of industrial equipment. There are great unknowns in this area but the best estimates to date indicate that known reserves of natural gas in Bass Strait are equal to the cumulative demand up to 2005 at least, and success in conservation education could extend this period.

This does not however take account of the deliverability of gas from the reserves. When a comparison is made of the best estimate of maximum deliverability from the Bass Strait fields with the maximum daily demand of the market, it is found that a shortfall could exist from 1990 onwards. There are many solutions to this problem, partly from the demand and partly from the supply side. From the demand side conservation should be looked at seriously.

The Corporation is engaged in a major programme of community education. It is actively engaged in the promotion of insulation, it runs energy management courses for industry and provides technical consultancy services to industry. It has sponsored and built demonstration low energy homes. It operates a central energy information centre to provide information to the public. It is developing and demonstrating gas/solar installations for domestic and commercial use. This programme is aimed at reducing the use of gas by wise use, not by conversion to some other form of energy which could be against the national interest. Success in the programme could postpone the deliverability shortfall into the late 1990's.

From the supply side we can consider a number of solutions:

Storage:

The prospects of increased peak deliverability through the use of storage in geological structures are doubtful. At present an L.N.G. peak shaving plant is being built and expansion of this concept is a likely means of postponing peak deliverability problems. In addition, of course, such storage gives security against plant and platform breakdowns and thus serves a double purpose. The present plant is being built in conjunction with an air separation plant producing oxygen and nitrogen and it is hoped that the combined plant will give significant energy savings as well as capital cost savings.

Discovery of Additional Reserves in Victoria:

Exploration in Victoria to date has been concentrated in the Gippsland Basin offshore. What exploration has been carried out onshore and in the offshore Otway Basin has had no success, and active exploration in these areas has ceased. Even in offshore Gippsland there have been no additions to gas reserves by new discoveries for many years. Nonetheless, it is believed that diligent exploration could yield new gas discoveries sufficient to provide the required deliverability through the 1990's. To this end, the Corporation has set up an exploration subsidiary which in conjunction with a joint venturer has commenced exploration over 2,500 sq. kilometres offshore Gippsland.

New Long Term Supply Sources:

Chief amongst these lie the prospective resources of the North West Shelf. However, the problem of transport across the 4,000 kilometres to a market which will be small at the start and grow as a result of market growth and reduced deliverability from existing sources, is difficult to solve without some form of Government involvement in the financing of the lines and explicit Government policy on availability of reserves of gas.

Another alternative long term supply source is S.N.G. from brown coal of which there are tremendous reserves in Victoria. Since it does appear that S.N.G. from brown coal can be delivered to the market at a price competitive with oil from brown coal or electricity from brown coal, this should be a viable alternative by the late 1990's and may well be, in the long term, the main source of gaseous fuel to the State.

As can be seen, the solution to the supply problem in Victoria does not present any technical difficulty. All the above alternatives are possible with today's technology. The difficulty lies in the choice of the most effective method or combination of methods. For example, the lead time for an S.N.G. from a coal plant might be ten years and for a trans-continental pipeline 7 years. A lot could change during this time so that a decision to take one route as against another could be found to be incorrect with disastrous financial consequences.

The first priority therefore must be to remove the risk of such error being caused. The major change that can take place during a 6-10 year gestation period to secure long term supply is new discoveries of gas close to Victoria. For this reason exploration throughout Victoria and adjacent areas must be carried out as soon as possible. This does not necessarily suit the private enterprise explorer looking for immediate inland sales. Consequently some Government or utility intervention either to carry out exploration or to compensate the explorer for his holding costs seems to be necessary. Assuming that this exploration work has still shown a demand for North West Shelf gas in the Eastern States, a prior requirement for construction of a pipeline is the dedication of reserves to it to ensure its economic viability. At present the Commonwealth attitude to export of L.N.G. is uncertain. Permission has been given to export 52% of the present known commercial reserves which after allowance for plant fuel and losses is equivalent to almost 65%. For such a project as this pipeline at least 20 year's requirements would seem the minimum dedication. This quantity does not seem available at present.

Taking our risk minimizing exercise a step further, even with North West Shelf gas, a case can be made for the installation of a coal conversion plant in 1990's. However, the capital cost of these plants and the risks inherent in such a large project makes it unlikely that any utility could afford a plant of the required size without Government involvement in the financing and risk sharing.

All in all this points towards an inevitable Government involvement in ensuring the continued smooth supplies to customers in Eastern Australia.

Summary:

From this description of the particular problems of one gas utility, general conclusions with regard to a national energy policy can be drawn. If it is desirable to minimize Australia's dependence on oil, then widespread replacement of oil in stationary applications by gas should be encouraged. To achieve this, confidence in long term availability and stability of price must be encouraged by:-

(a) Government action to ensure a proper level of exploration by all possible means.
(b) Explicit Government policy on natural gas export so as to maintain sufficient resources dedicated to inland use to justify investment in distribution and utilization facilities.
(c) Government commitment either to construct or to guarantee the viability for private investors of large energy projects such as a trans-continental pipeline and coal conversion plants.

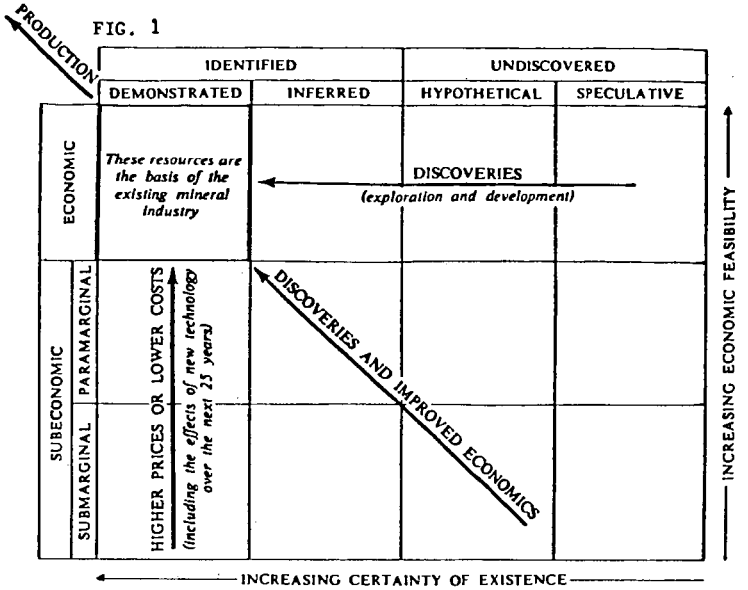
References:

1. Australia's Energy Resources, an assessment. National Energy Advisory Committee Report No. 2.

2. Demand for Primary Fuels Australia 1976/77 to 1986/87. Report by Department of National Development - April 1978.

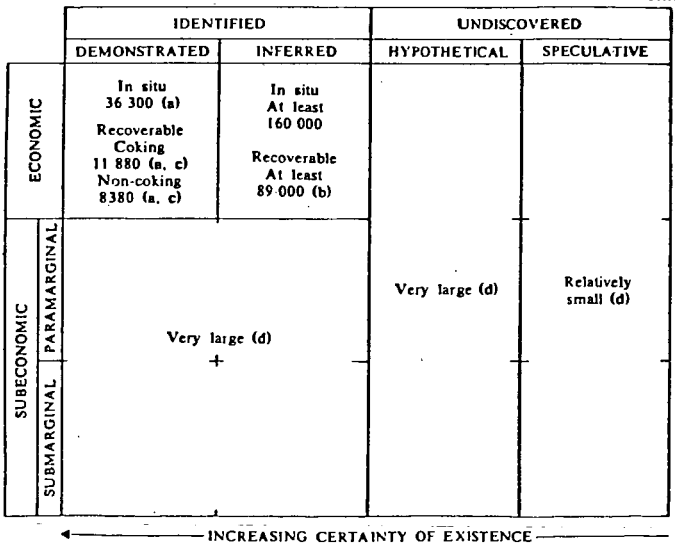
3. Australian Natural Gas Utilization and Transportation Study. Prepared for The Pipeline Authority - October 1976.

FIG. 1



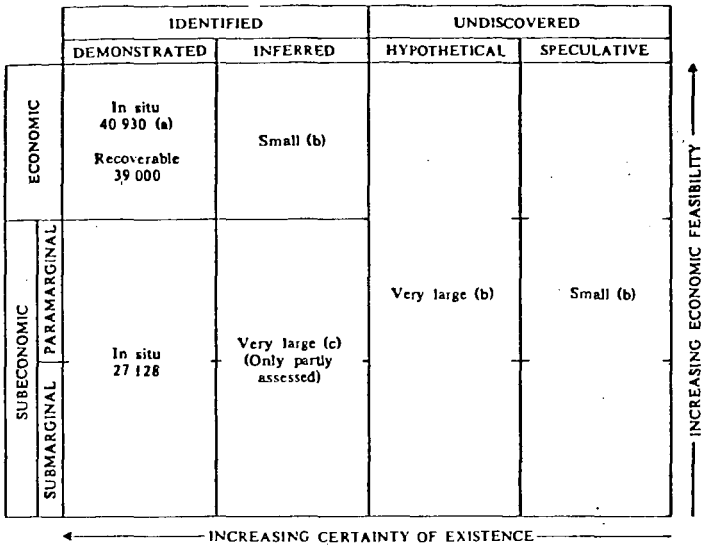
Resource classification diagram showing the general progression of non-renewable resources as a result of exploration, research, development and production.

FIG. 2 AUSTRALIA'S RESOURCES OF BLACK COAL (10^6 tonnes)



(a) Results of drilling since 1973 will increase this figure. (b) A mining recovery rate of 55.8 per cent is assumed (see text). (c) For reasons given in the text, distinctions between coking and non-coking coals are becoming increasingly less meaningful. (d) No quantitative assessment available.

FIG. 3 AUSTRALIA'S RESOURCES OF BROWN COAL (10^6 tonnes)



(a) Total includes 5000 million tonnes in Victoria located beneath township planning scheme areas.
(c) Includes at least 54 500 million tonnes in Victoria. (b) No quantitative assessment available.